Job Progress Report

RESEARCH

State: New Hampshire

Cooperators: Animal Sciences Department and
Electrical Engineering Department
of the University of New Hampshire
New Hampshire Fish and Game Department

Project No.: W-51-R-5 Title: Laboratory Analyses of Game and Game Foods

Job No. 10 Title: INVESTIGATION OF PERIOD REQUIRED FOR INCREASE IN METABOLISM OF DEER FROM WINTER TO SUMMER LEVEL

Period Covered: April 1, 1971 to April 30, 1971

I. Summary:

Three 10-month old fawns were used in an intensive study of metabolic rate during early spring. A total of 27 on-feed metabolic rate determinations were made during the period March 26 - May 21, 1971. Highly variable within-animal metabolic rates gradually gave way to less fluctuating values after mid-April.

The data suggest deer do not undergo a single abrupt change in metabolic rate during early spring, but rather enter a period of fluctuation prior to stabilization at an increased summer rate.

III. Background:

Since its initiation, energy metabolism studies with white-tailed deer, this project has documented several interesting phenomena. Silver et al. (1969) presented evidence indicating the metabolic rate in deer varies with season, with a substantially higher rate occurring during summer than winter. Their observations indicated a marked decrease in metabolic rate during the period August - September with an increase occurring during the April - May period. During the recent browse study conducted under this project (W-51-R-4) incidental findings suggest that the spring transition period results in a major increase in metabolic rate over a relatively short period of time. The present investigation was undertaken to gain a better understanding of both the abruptness and magnitude of this spring change in metabolic rate.

IV. Objectives:

To intensively measure the metabolic rate of white-tailed deer during early spring in an attempt to document the abruptness and magnitude of the reported spring increase in energy expenditure (or, to determine the abruptness and magnitude of change in metabolic rate in deer during early spring).

V. Procedures:

The metabolic rates of three 10-month old deer were monitored throughout the month of April and during early May by means of indirect calorimetry. A total of 27 trials was conducted over a period of 56 days. Each trial consisted of one 21- to 24-hour period in the respiration chamber during which oxygen consumption and carbon dioxide and methane production were measured.

The chamber temperature for all trials was maintained at approximately 18-19° C. which is believed to be within the zone of thermoneutrality for deer (Silver et al., 1971). When not in the chamber, the animals were held in large outdoor holding pens. Each deer was crated and brought indoors 10-15 hours prior to the time it entered the chamber.

It was impossible to subject the animals to successive fasts over so long a period; a constant amount of feed (varying between deer) was fed to each animal during the chamber trials. Measurements obtained were thus of standard metabolic rate rather than fasting metabolic rate. For comparative purposes, fasting metabolic rates were estimated by subtracting the heat increment values of the ingested food. The per gram heat increment values used for these calculations were obtained from energy requirement studies conducted in October and January on these same animals (current fawn study, this project). On-feed and fasting trials were conducted at the same chamber temperatures and using the same ration as the current work.

VI. Findings:

Metabolic rates of the deer were extremely variable during the period March 26 through May 21 (Table 1). Within-animal differences between consecutive weekly measurements of metabolic rate ranged from ± 2 percent to 70 percent. This variation was most pronounced during the early phase of the work, through mid-April, with a more stable metabolic rate observed after that time.

VII. Discussion:

The data obtained during the March - May experiment indicate extreme variability in metabolic rate during the spring transitional period. More data is needed to ascertain whether this variability is typical throughout the year or primarily during the spring transitional period. The limited data reported here suggest a lessening of within-animal variability as the spring progresses (Fig. 1). Three consecutive 24-hour trials, conducted May 18-21 on Deer No. 6 showed a fairly stable metabolic rate at this time (Table 1).

We feel the spring transition period may have been underway prior to the initiation of this experiment, at least for one of the three deer. Metabolic rates from Deer No. 4 were variable from the start and, in addition, the first two measurements were both much higher than the basal rate

VII. Discussion, contd.:

recorded for this animal in January. Conversely, the late March and early April metabolic rates of Deer No. 1 and Deer No. 6 were similar to those recorded for these animals in mid-winter, indicating possibly that these animals had not yet entered the spring transition period. In addition, a definite increase in metabolic rate did occur during the period of the study in Deer No. 1 and Deer No. 6 while Deer No. 4 displayed a less marked change in metabolic rate. Thus, as might be expected, the exact time of the spring increase in metabolic rate appears to vary between deer. It also seems likely that the time of this change varies from year to year, depending on climatic conditions. More work is needed to resolve these questions. The high degree of within-animal variability, the differences in timing between animals, and the yearly differences are all factors which make the concise measurement and documentation of this parameter a difficult task.

VIII. Recommendations:

1) Spring as well as fall "transition" periods should be more fully investigated with reference to intra- as well as inter-animal differences and to the variations in these rates at other times of the year.

2) Other parameters of metabolic activity should be investigated in conjunction with additional indirect calorimetric trials. It might be possible to ascertain the metabolic "state" of a deer without undergoing a 24-hour respiration chamber trial.

3) An attempt should be made to correlate climatic conditions, both before and during the transitional period, with the changes observed in metabolic activity.

IX. Literature Cited:

Silver, Helenette, N. F. Colovos, J. B. Holter, and H. H. Hayes. 1969. Fasting metabolism of white-tailed deer. J. Wildl. Mgt. 33(3):490-498.

_____, _____, _____, and _____. 1971. Effect of falling temperature on heat production in fasting white-tailed deer. J. Wildl. Mgt. 35(1):37-46.

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Table 1 - Metabolic rates for three 10-month-old fawns during the period March 26-May 21 as determined by indirect calorimetry (UNH, 1971).

Date	Deer	Sex	Weight (kg)	Grams Food Consumed/Trial	On-Feed Metabolic Rate (kcal/kg$^{3/4}$)	Estimated FMR (kcal/kg$^{3/4}$)
Oct. 27[a]	1	M	--	1300	172	117[b]
Jan. 19[a]	1		--	768	139	92[b]
Mar. 28-29	1		37.9	1200	152	90
Apr. 4- 5	1		38.6	1200	175	114
Apr. 9-10	1		36.1	565	153	91
Apr. 14-15	1		38.6	1200	148	86
Apr. 18-19	1		38.7	1200	135	74
Apr. 28-29	1		38.8	1200	168	107
May 11-12	1		39.5	1200	164	102
May 16-17	1		39.7	1200	168	107
Oct. 4[a]	4	M	--	1000	173	101[b]
Jan. 18[a]	4		--	400	103	71[b]
Mar. 26-27	4		32.6	800	150	90
Apr. 2- 3	4		32.3	800	146	85
Apr. 6- 7	4		33.2	800	114	54
Apr. 13-14	4		32.5	800	153	92
Apr. 17-18	4		32.8	800	128	68
Apr. 27-28	4		33.6	800	139	79
May 5- 6	4		35.5	800	157	96
May 13-14	4		34.9	800	151	90
May 17-18	4		36.6	400	149	88
Nov. 10[a]	6	F	--	800	173	108[b]
Feb. 1[a]	6		--	626	109	64[b]
Apr. 5- 6	6		30.9	700	117	63
Apr. 11-12	6		30.3	700	148	94
Apr. 16-17	6		30.7	700	116	62
Apr. 25-26	6		32.2	700	108	54
Apr. 29-30	6		31.2	700	117	63
May 6- 7	6		31.7	700	137	83
May 12-13	6		33.0	700	160	106
May 18-19	6		33.3	700	150	96
May 19-20	6		33.0	700	159	105
May 20-21	6		32.6	700	155	101

[a] data from fawn energy requirement study, C. B. Thompson, this project.

[b] actual determination of FMR

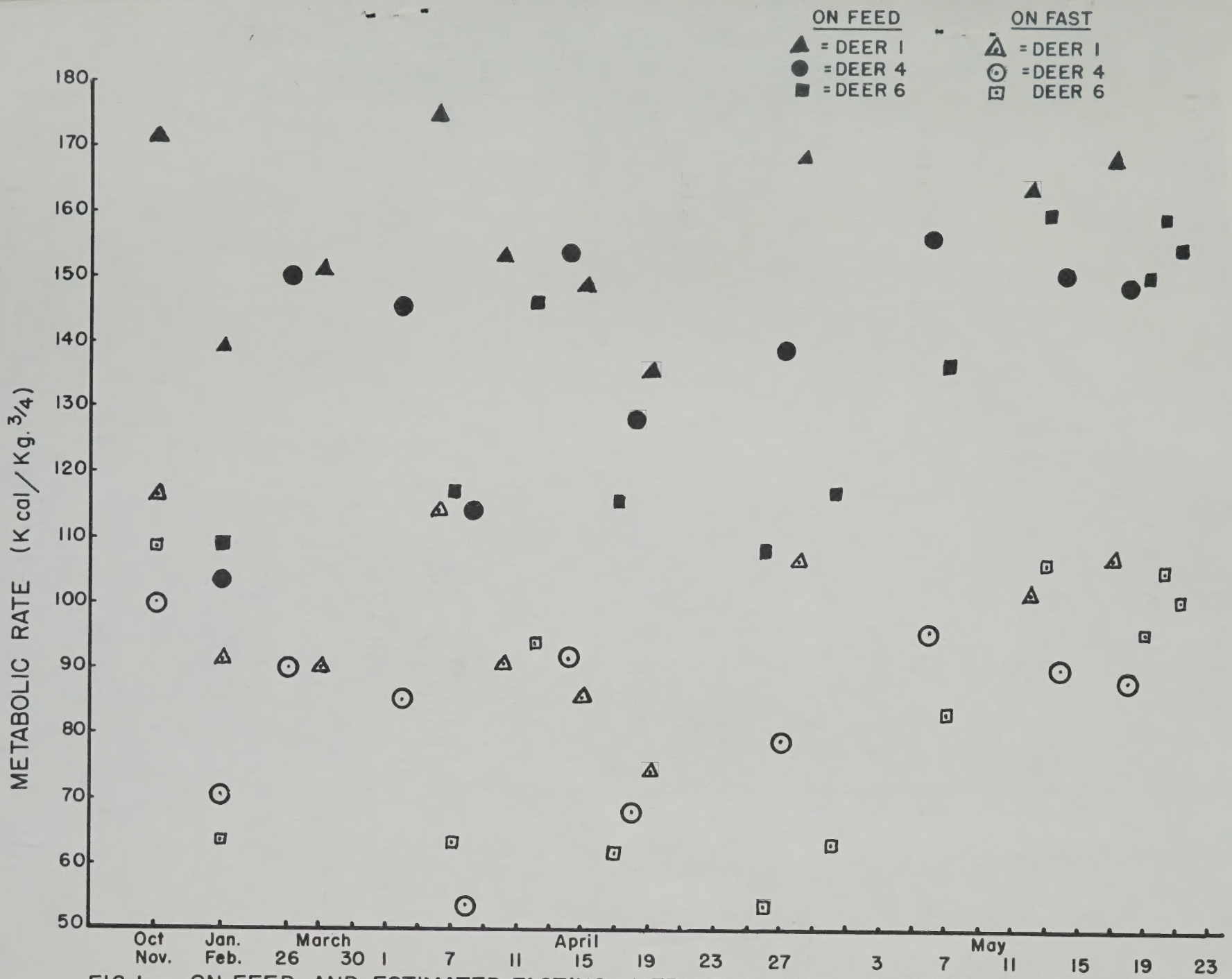

FIG. 1 ON FEED AND ESTIMATED FASTING - METABOLIC RATE VS. DATE FOR THREE TEN MONTHS OLD DEER DURING EARLY SPRING. (U.N.H. 1971)